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POLICY MATTERS
Fast Setting Concrete Unit Costs and Its Effects on Longer-Life Pavement Policy
Information Item

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CURRENT COST OF FAST SETTING CONCRETE AND ITS EFFECT ON THE LONGER-LIFE PAVEMENT REHABILITATION PHILOSOPHY

ISSUE

At the March 2001 CTC meeting, the Commission asked the Department to re-evaluate the longer-life pavement rehabilitation philosophy taking into consideration that the unit cost for fast setting concrete has increased since the initiation of that philosophy.

DISCUSSION

FAST SETTING CONCRETE AND ITS COST

Background:

The Department has been using additives in concrete mixes to accelerate the time it takes for them to set and obtain strength since the late 1960's and early 1970's in heavy traffic areas. However, those additives only accelerated the time to set from days down to between 8 and 12 hours. As the years passed and traffic volumes grew in California and further limited the time available to perform the needed pavement repairs, the 8 to 12 hour timeframe was no longer acceptable from a long term pavement performance perspective. The Department by the early 1990's was seeking alternative additives, new materials and additional repair strategies for use.

During the reconstruction of the freeway system that was damaged in 1994 from the Northridge Earthquake, new cement materials became more readily available and were used to accelerate the reconstruction of bridge approach slabs. Building upon that success, the Department began investigating using these new cements in a way that they had never been used before - in concrete for pavement rehabilitation strategies. The benefit of using these materials was that they enabled the Department to construct the needed pavement repairs, at certain locations, in very limited timeframe and provide a pavement repair that will perform long term (30 to 40 years). It is typical today for the pavement repairs needing to be completed and in-place in a 4 to 6 hour timeframe to minimize traffic delays. In 1997,

Caltrans began advertising pavement rehabilitation projects using these new materials when their use was warranted because of the need to mitigate traffic delays.

The Cost of Fast Setting Concrete.
The addition of additives and the use of high strength cements add costs to the unit price of concrete. When the new cements were initially used in 1997/98 on demonstration projects for the Department, the cost for removing and replacing concrete pavement with fast setting concrete was anticipated to be 3 to 4 times the average price of using unaltered "normal" concrete. Thus, when using the new materials the average price was estimated to be in the range of $450 to $600 per cubic meter versus $150 to $160 per cubic meter for "normal" concrete. Once the demonstration projects were completed and controlled routine use of the new cements began, the average price of removing and replacing existing concrete pavement with the fast setting concrete increased to an average of:

- $535 per cubic meter in 1999;
- $846 per cubic meter in 2000; and,
- $867 per cubic meter on the limited number of projects bid so far in 2001.

In comparison, the unit price for the 8 to 12 hour accelerated setting concrete used previously to the new cements have averaged:

- $406 per cubic meter in 1997;
- $400 per cubic meter in 1998;
- $391 per cubic meter in 1999; and,
- $398 per cubic meter in 2000.

To date, no projects have been bid using this material in 2001.

Currently, the costs for removing and replacing the existing concrete with these new fast setting materials that gain the required strength in 4 to 6 hours is approximately 6 times the cost for these repairs if "normal" concrete were to be used. This is up from the original estimate made in 1997/98, which was 3 to 4 times the price of doing these repairs with "normal" concrete. Reasons why this is happening are:

Additional Contractor and Supplier Risks: One of the reasons the Department began with demonstration projects was to showcase the use of these materials to both the California contracting industry and the material suppliers that needed to produce the material. By doing so, Caltrans was trying to inform both of those groups that this material would require additional attention during production and placement. These cement materials also need to be handled separately during concrete production. Thus, the unit price bids for this material would be expected to be higher than "normal" concrete.

Supply and Demand: The cements used to manufacture the fast setting concrete are in limited supply. Another reason for the demonstration projects was to indicate to the material suppliers that there is a need for their products and that there would be a market for them in the future. The desire was that they would gear-up their manufacturing capabilities. As a result, even though the bids have been competitive, they are coming in at higher prices than expected.

Additional Contractor Trial Mixing and Testing Requirements for Quality Control: The latest version of the specification for this material requires the Contractor to perform additional quality control work. Placing a trial batch mix and performing quality control testing for contract administration purposes were not in earlier versions of the specification.

Higher Energy Costs to Produce and Deliver the Material plus Construct the Repairs: Various material suppliers have notified the Department that prices for their materials may be increasing in response to high energy prices they are being charged to produce and deliver their materials. In addition, the cost of fuel to run the Contractor's equipment has also increased, which results in higher bid prices.

Departmental Actions to Manage Project Costs, when the use of Fast Setting Concrete is required.

1. Confirm that the use of fast setting concrete is warranted at the time of project scoping and pavement type selection, which is an engineering decision made on a project-by-project basis. Other options may be available to expedite the construction and still provide the needed pavement quality and service.
2. Improving the specifications for the material so that required strength gain matches the timeframe available for the construction activities. In general, the quicker the work is needed to be completed and smaller the timeframe to complete it, the higher the prices bid by the Contractor will be. The timeframe that is available for each project is being reviewed so that the largest timeframe available is used to perform the work.
3. Partnering with the Contractors and material suppliers so that their knowledge of the material will be enhanced and their perceived risks will be less. Each project has specified into its contract that a training session is held so that Department and key Contractor and supplier personnel are in attendance.

LONGER-LIFE PAVEMENT REHABILITATION

Background:

Longer-lasting pavement rehabilitation strategies, especially in urban areas, by minimizing future maintenance and rehabilitation induced user delay costs to the public, are warranted when analyzing the project economically using life-cycle costing procedures. Longer-life pavement strategies may also be warranted depending upon other project-related factors (the strength and condition of the existing pavement, the types of materials that are to be used, the weather climate that the pavement is in, constructability issues, dependability of the alternative strategies, etc.) in non-urban areas. Threshold values of 150,000 Annual Average Daily Traffic (AADT) and 15,000 Annual Average Daily Truck Traffic (AADTT) have been established by the Department to define urban areas. It is important to note, however, that these values are thresholds and were only developed to guide the highway engineers that are responsible for decisions related to pavement type selection.

Pavement type selection, which is an engineering decision made on a project-by-project basis, should be made by conducting a comparative economic life cycle cost analysis using Caltrans procedures to analyze the alternative strategies that are viable for the project. The goal is to select the pavement strategy that will provide the highway user with the best possible service at the lowest overall cost, including user costs.

It is important to remember that using fast setting concrete is not the sum total of long-life pavement rehabilitation. Fast setting concrete is a material, that when used in the right location and in the correct manner can accelerate the construction of a given project and minimizes user delays. Long-life pavement rehabilitation is a philosophy that has been adopted by the Department. This philosophy incorporates the following concepts:

- Doing the correct type of repair at the correct time;
- Maximizing the service life of the repairs;
- Managing the traffic so that construction related delays are mitigated in a manageable manner; and,
- Allowing the Contractor, to the maximum extend possible, manage the project so that they can complete the work using their equipment and personnel in the most efficient manner to get the work done in the least amount of time and yet still provide a long lasting quality product for the taxpayers.

Effect of Higher Fast Setting Concrete Costs on the Economic Evaluation Completed Previously that Established the Longer Life Rehabilitation Thresholds.

The economic analysis previously completed in 1997 that established the longer life pavement rehabilitation thresholds was based upon a generic longer life rehabilitation project. The generic project utilized historical average project cost data that was higher than that of a slab/lane replacement project (a typical fast setting concrete project). Therefore, the previously defined thresholds are still valid.

In general, higher initial project costs, such as what has happened with Fast Setting Concrete, have minimal effect on the outcome when using life cycle costing techniques. The most significant factor when using life cycle costing procedures are the user delay costs. This is especially true if the user costs are large enough, as is the situation in California. Therefore, even though the cost for fast setting concrete has gone up significantly when compared to its own unit cost, as far as life cycle costing analysis procedures, the increase is insignificant.